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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/537,591
Filing Date: June 06, 2005
Appellant(s): RIJKS ET AL.

Ira S. Matsil
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed on 4/27/2009 appealing from the Office action mailed 9/24/2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US 4,674,180	ZAVRACKY	1-1987
US 2004/0058532	MILES	3-2004

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US 6,618,034	SUGAHARA	9-2003
US 6,674,562	MILES	1-2004

(9) Grounds of Rejection

Please note that the rejection below has been modified, relative to the rejection in the final office action, to include the after final amendments dated 11/19/2008, entered on 12/12/2008 (102 rejection Claims 1 and 13 using Zavracky and 103 rejection of Claims 1, 11, and 13 using Miles '532 and Sugahara have been modified to be consistent with the amended claims).

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 6-9 and 11-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Zavracky et al. (US 4,674,180). Regarding Claim 1, Zavracky discloses an electronic device (Figures 1-8, 10-13) comprising: an array (array of 121,122, 123) of micro-electromechanical system (MEMS) elements 10 including at least first and second MEMS elements (see for example, MEMS elements 10 of 121,122 in Figure 8), said array being connected by an input and an output (input and output through communication bus 127, 128) and providing a plurality of states at its output F1, F2, wherein each of the first and second MEMS elements has a characteristic hysteresis curve, a first state and a second state (see MEMS 10 having closed and open states drawn with hysteresis curve in Figures 7-8, 11, also see Column 3, lines 46- 48, Column 5, line 64 - Column 6, line 1), and wherein a transition from the first to the second state is effected by an opening voltage, and a transition from the second to the first state is

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effected by a closing voltage (characteristic of an element having hysteresis), the opening voltage and closing voltage of the first MEMS element being different from the opening voltage and closing voltage of the second MEMS element (each MEMS having different hysteresis curve, have different opening and closing voltages), and

wherein the characteristics curves differing from the first MEMS element to the second MEMS element are designed such that the hysteresis curve having a smaller width is located fully within the width of the hysteresis curve having the larger width (Column 7, lines 40-44); and

wherein the input is adapted for applying a single control voltage that is to be applied to all the MEMS elements whereby the various states of the array are to be obtained by varying the single control voltage (single input voltage is applied to all MEMS elements 10 in Figures 8, 11, through communication bus 127,128),

Regarding Claim 2, Zavracky discloses that the array includes at least three MEMS elements (see for example, MEMS elements 10 of 121,122, 123 in Figure 8) each having a characteristic hysteresis curve, such that the opening voltage is different from the closing voltage, which characteristic hysteresis curves and the corresponding opening and closing voltages differ from one MEMS element to another MEMS element.

Regarding Claims 3-4, Zavracky discloses that the MEMS elements in the array are connected in parallel (see MEMS elements 10 of 121 to 123 arranged in parallel), wherein the number of MEMS elements in the array is in the range from 2 to 10.

Regarding Claim 6, Zavracky discloses a plurality of arrays of MEMS elements, each array having an input for a single control voltage (array 121-123 and array 124-126 has a single control voltage through 127, 128).

Regarding Claim 7, Zavracky discloses that each of the MEMS elements in the array has a fixed electrode and a movable electrode that is movable towards and away from the fixed electrode by application of the closing and the opening voltage respectively, such that in the first state the distance between the fixed and the movable electrode is smaller than in the second state, which movable electrode is suspended substantially parallel to the fixed electrode and anchored to a support structure by at least one cantilever arm having a spring constant, which MEMS element is provided with an actuation electrode with an actuation area for provision of the closing and opening voltages.

Regarding Claim 8, Zavracky discloses that the first and second MEMS elements in the array have different characteristic hysteresis curves in that actuation areas of control electrodes of the first and second MEMS elements are different and/or spring constants of cantilever arms are different.

Regarding Claim 9, Zavracky discloses that at least one dielectric layer having a dielectric permittivity is present between the fixed and the movable electrode, such that the MEMS element is a MEMS capacitor, of which capacitor the first state has a first state capacitance, and a first and a second MEMS capacitor in the array have different characteristic hysteresis curves in that the first state capacitances of the first and the second MEMS capacitor are different.

Regarding Claim 11, Zavracky discloses that the characteristic hysteresis curves of the first and second MEMS elements are centered around a common centerline in the operational diagram (selecting hysteresis curves to get different logic states with single voltage sweep, see 46-53).

Regarding Claim 12, Zavracky discloses a method of driving an array of micro-mechanical system (MEMS) elements according to Claim 1, wherein a single control voltage is applied in common to the MEMS elements in the array, which voltage is varied to obtain the various states of the array (see input to MEMS elements 10 of the array through communication bus 127, 128).

Regarding Claim 13, Zavracky discloses an electronic device (Figures 1-8, 10-13) comprising: a first MEMS element (MEMS element 10 of 121) having a first characteristic hysteresis curve and a first state and a second state, a transition from the first to the second state being effected by a first opening voltage, and a transition from the second to the first state being effected by a first closing voltage (see MEMS 10 having closed and open states drawn with hysteresis curve in Figures 7-8, 11, also see Column 3, lines 46-48, Column 5, line 64 - Column 6, line 1);

a second MEMS element (MEMS element 10 of 122) having a second characteristic hysteresis curve that is different than the first characteristic hysteresis curve, the second MEMS element also having a first state and a second state wherein a transition from the first to the second state is effected by a second opening voltage, and a transition from the second to the first state is effected by a second closing voltage, the second opening voltage being different than a first opening voltage and the second

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closing voltage being different than the first closing voltage (see MEMS 10 having closed and open states drawn with hysteresis curve in Figures 7-8, 11, also see Column 3, lines 46-48, Column 5, line 64 - Column 6, line 1);

wherein the first characteristic hysteresis curve has a smaller width than the second characteristic hysteresis curve and wherein the first characteristic hysteresis curve is located fully within the second characteristics curve (Column 7, lines 40-44); and

a single common input (see input to MEMS elements 10 of the array through communication bus 127, 128) coupled to both the first MEMS element and the second MEMS element, wherein state transitions within the first MEMS element and within the second MEMS element are only effected by a control voltage applied to the single common input (MEMS elements are connected in parallel and therefore, the single control voltage is applied to each MEMS elements).

Regarding Claims 14-17, Zavracky discloses the first and second MEMS elements each include a fixed electrode 102 and a movable electrode 105 that is movable towards and away from the fixed electrode by application of the control voltage applied to the single common input, wherein the distance between the fixed and the movable electrode is smaller in the first state (closed) than in the second state (open) (see Figures 1-4), wherein the movable electrode is suspended substantially parallel to the fixed electrode and anchored to a support structure (one end of 105 connected to 100) by at least one cantilever arm having a spring constant (one end of 105 connected to 100), each MEMS element further having an actuation electrode 100 with an

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actuation area for providing the closing and opening voltages, wherein the first and second MEMS elements each include a dielectric layer having a dielectric permittivity between the fixed and the movable electrode, such that each MEMS element is a MEMS capacitor (see Column 5, lines 61-63).

Regarding Claims 18-20, Zavracky discloses the first MEMS element comprises a first MEMS capacitor and wherein the second MEMS element comprises a second MEMS capacitor such that the electronic device comprises a variable capacitor (see Figure 2, Column 5, lines 39-44), wherein application of the control voltage to the single common input can cause the variable capacitor to take on at least four different capacitance values (each MEMS elements having two states, open and closed, results in four states or capacitance values), further comprising at least one further MEMS element (MEMS element 10 of 123) coupled to the single common input, wherein application of the control voltage to the single common input can cause the variable capacitor to take on more than four different capacitance values (3 MEMS elements each having 2 states results in more than four different states or capacitance values).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 6-9, 12-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over by Miles et al. (US 2004/0058532) (Miles '532) in view of Sugahara et

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al. (US 6,618,034). Regarding Claim 1, Miles '532 discloses an electronic device comprising an array of micro-electromechanical system (MEMS) elements 10 (Figures 1-9, Paragraph 20) including at least first and second MEMS elements (MEMS elements/IMOD devices 10 are fabricated in large arrays as recited in Paragraph 20), said array being connected by an input and an output and providing a plurality of states at its output (each MEMS element of the array having characteristic response results in plurality of states at the output), wherein each of first and second the MEMS elements has a characteristic hysteresis curve, a first state and a second state (displaced/driven and undisplaced/undriven state), and wherein a transition from the first to the second state is effected by an opening voltage V_{release} , and a transition from the second to the first state is effected by a closing voltage $V_{\text{actuation}}$, the opening voltage and closing voltage of the first MEMS element being different from the opening voltage and closing voltage of the second MEMS element (see Figures 5, 7, Paragraphs 22, 28-29), and wherein the characteristic hysteresis curves differing from the first MEMS element to the second MEMS element by their individual width are designed such that the hysteresis curve having a smaller width is located within the width of the hysteresis curve having the larger width (see Curve 50 of individual IMODs/MEMS 10 with hysteresis width 2.8 volts as shown in Paragraph 28 and Figure 5, V_{release} of individual devices differs around 5 volts and $V_{\text{actuation}}$ at 7.8 volts and thus curves fully enclosed within the other, also see curve 80 with hysteresis width 4.5 volts as shown in Paragraph 29 and Figure 7); and

wherein the input is adapted for applying a control voltage V_{bias} that is to be applied to all the MEMS elements whereby the various states of the array are to be obtained by varying the control voltage (see Paragraph 22, 28-29, Figures 5,7 with V_{bias} on the x-axis).

Miles does not specifically disclose that the control voltage applied to all the MEMS is a single control voltage and does not specifically disclose that the hysteresis curves with more distinguishable widths are in the same array.

Sugahara discloses an electronic device comprising an array of MEMS elements 230a (see Figures 9, 11) where a single control voltage is applied to all the MEMS elements (see a single voltage V_1 is applied to top array, V_2 to the next array) and MEMS elements having different length for the displacement electrode resulting in hysteresis curves having different widths (see Figure 10, width of A'A is about 3.6 volts, B'B about 4,6 volts, C'C about 5.6 volts).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a single control voltage to drive the MEMS elements of Miles, because Sugahara teaches the use of a single control voltage to drive all the MEMS elements in an array and teaches that using only a single control voltage would reduce the number ICs required and results in a simple drive circuit (see Sugahara, Column 1, lines 12-35), and to use MEMS elements (in Figure 5 and 7) of Miles '532 with clearly distinguishable widths in the same array, because Sugahara teaches the use of MEMS elements having different widths in the same array to obtain various logic states using the same array.

Regarding Claim 2, Miles '532 discloses that the array includes at least three MEMS elements (10 is large array and has at least three MEMS elements) having a characteristic hysteresis curve, such that the opening voltage is different from the closing voltage, which characteristic hysteresis curves and the corresponding opening and closing voltages differ from one MEMS element to another MEMS element (see Figures 5, 7, Paragraphs 22, 28-29).

Regarding Claim 2-4, 6, Sugahara teaches the MEMS array elements ranging from 2-10, connected in parallel, comprising plurality of arrays of MEMS elements, each array having an input for a single control voltage (see Figures 10-11). Regarding Claim 7, Miles '532 discloses that each of the MEMS elements in the array has a fixed electrode 12 and a movable electrode 14 that is movable towards and away from the fixed electrode by application of the closing and the opening voltage respectively, such that in the first state (displaced state) the distance between the fixed and the movable electrode is smaller than in the second state (undisplaced state), which movable electrode is suspended substantially parallel to the fixed electrode (see Figures 1-2) anchored to a support structure 18 by at least one cantilever arm having a spring constant (see arms of 14 with one end on 18 in Figure 2), which MEMS element is provided with an actuation electrode 20 with an actuation area for provision of the closing and opening voltages (Paragraph 19).

Regarding Claim 8, Miles '532 discloses that the first and second MEMS elements in the array have different characteristic hysteresis curves in that actuation areas of control electrodes of the first and second MEMS elements are different (see

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Paragraph 22, different layer thickness results in different cross sectional area of the electrode).

Regarding Claim 9, Miles '532 discloses that at least one dielectric layer Al₂O₃ having a dielectric permittivity is present between the fixed and the movable electrode, such that the MEMS element is a MEMS capacitor, of which capacitor the first state has a first state capacitance, and a first and a second MEMS capacitor in the array have different characteristic hysteresis curves in that the first state capacitances of the first and the second MEMS capacitor are different (see Paragraphs 22, 28-29, Figures 5, 7, reflectance shown on Y-axis varies due to change in capacitance/charge trapping).

Regarding Claim 12, Miles '532 discloses a method for driving 22 an array of micromechanical system (MEMS) elements of Claim 1, wherein a control voltage is applied in common to the MEMS elements in the array, which voltage is varied to obtain the various states of the array (see Figures 1-2, drive mechanism 22 apply control voltage to electrode 20).

Regarding Claim 11, Miles and Sugahara do not specifically disclose that the curves of the MEMS elements are centered around a common centerline in the operational region. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the combination of Miles '532 and Sugahara, and to design the MEMS elements, to have offset voltage to center the curves, to set and apply the range of bias voltage more easily.

Claims 13-16 basically recites the elements of Claims 1 and 7-9, except that the first MEMS element and characteristics and the second MEMS element characteristics

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are recited. Therefore, please see the rejections for Claims 1 and 7-9 recited above.

Regarding Claims 17-20, both Miles and Sugahara disclose MEMS capacitors with the recited characteristics.

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zavracky et al. (US 4,674,180) in view of Miles (US 6,674,562) (Miles '562) or alternatively Miles et al. (US 2004/0058532) (Miles '532) in view of Sugahara et al. (US 6,618,034) and Miles (US 6,674,562) (Miles '562).

Regarding Claim 5, Zavracky or Miles '532 and Sugahara do not disclose that the input for a single control voltage is from a transistor. Miles '562 discloses an MEMS device 410 (see Figure 4C) where the input for a single control voltage is from a transistor (see transistors 404 output given to 410). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Zavracky/Miles '532 and Sugahara, and to include a transistor as taught by Miles 562, as a means to provide variable voltage levels for the single control voltage.

(10) Response to Argument

I. Rejection of claims 1-4, 6-9, and 11-20 under 35 U.S.C. § 102(b) over Zavracky

The Appellant argues, on Page 6 of the Appeal Brief that Zavracky does not meet the limitation of **Claim 1**, “the hysteresis curve having a smaller width is located fully within the width of the hysteresis curve having larger width” and that Zavracky does not disclose changing the width of the hysteresis curves, rather, silent regarding the opening voltage of the shunt.

Examiner respectfully disagrees. Hysteresis characteristics of a MEMS device means hysteresis width and threshold voltages – opening voltage (or release voltage) and closing voltage (or actuation voltage) of the hysteresis curve. In Column 7, lines 40-44, Zavracky discloses, “each successive micromechanical shunt circuit element 140, 141, 142, 143, 144, 145, 146, 147 has a slightly higher closure threshold voltage determined mainly by the dimensions of the cantilever beam contained therein, ” and in Column 7, line 65 – Column 8, line 1, discloses, “This variation in length of the cantilever beam provides one of the several ways to vary the threshold voltage of the shunt because longer cantilever beams require lower threshold voltages for closure, all other characteristics being equal.” In Figure 21, Zavracky discloses a plurality of MEMS elements, each having cantilever beam 105 of different length. Zavracky’s MEMS devices have different hysteresis characteristics as the devices have different cantilever beam dimensions.

Examiner agrees that Zavracky is silent regarding the opening voltage. When the length of the cantilever beam is varied, it is inherent that both the threshold voltages, opening voltage and closing voltage, and the width of the hysteresis curve are varied. When the cantilever beam dimensions are varied, area is varied, its capacitance is varied corresponding to the change in area, and the amount of charge trapping is varied, and therefore, the width of the hysteresis loop and both threshold voltages are varied. In another words, when the cantilever beam length is varied, the voltage required to bring the cantilever beam 105 to the force plate 102 increases, once it is closed it would take the same amount of voltage to bring it back to fully open or

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released state by releasing all trapped charges. Zavracky discloses increasing the closure threshold voltages by decreasing the length of the cantilever beam, since each successive MEMS element 140-147 has slightly higher closure threshold voltage and width, each successive hysteresis loop would fully enclose the previous ones.

The Appellant argues, on Page 7 of the Appeal Brief that Zavracky does not teach or suggest that opening voltage increases while the closing voltage decreases.

In response, Examiner notes that claims does not recite that the opening voltage increases while the closing voltage decreases; Claim only recites that the opening voltage and closing voltage of the first MEMS element being different from the opening voltage and closing voltage of the second MEMS element, with characteristics hysteresis curves differing from the first element to the second, and Zavracky discloses the limitation as discussed above.

The Appellant argues in an illustrative example, on Pages 7-8 of the Remarks that upon an increase in cantilever beam length, if the opening voltage decreases by about the same as the decrease in threshold voltages for closure, the hysteresis width remains unchanged, and that in such case, an increase in threshold voltage for closure arising from a decrease in cantilever beam length will not result in a wider hysteresis width.

In response, Examiner notes that there is no support for this example in Zavracky as Zavracky does not disclose or teach that the hysteresis width kept unchanged or decreasing the opening voltage when the closing voltage is decreased.

Examiner further notes that Claim 1 only recites that first and second MEMS elements are **designed** such that the hysteresis curve having a smaller width is located fully within the width of the hysteresis curve of the larger width, no specifics of the design is recited or shown in Figures (Figure 10 shows the structure of one MEMS capacitor, not a second or third to indicate how the MEMS capacitors design is different, in length, thickness, width or (insulating) layer, to have the design as recited in the claim).

The Appellant argues on Page 9 of the Appeal Brief that Zavracky fails to anticipate the elements of **Claim 2**.

In response, Examiner notes that Claim 2 further limits the array of Claim 1 having the first and second MEMS elements to have an additional MEMS element. Zavracky discloses at least three MEMS elements in the array as shown in Figure 8 (MEMS elements 10 of 121, 122, 123), each having a characteristic curve, with different width and opening and closing voltages. Please see the response to arguments to Claim 1 above, with regard to the arguments that Zavracky is silent regarding the opening voltage of the shunt.

The Appellant argues, on Page 9 of the Appeal Brief that Regarding **Claim 9**, Zavracky fails to anticipate that the first and the second capacitance are different.

Examiner respectfully disagrees. Zavracky discloses that a first and a second MEM having different length of the cantilever beam, resulting in different capacitance for the first and second MEM. Capacitance between cantilever beam 105 (Figure 1) and contact plate 102, varies with in proportion to the spatial relationship between cantilever beam and contact plate. Capacitance also varies depending on the area of the

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capacitor plate, and the area varies when the length varies, as capacitance, $C = \epsilon A/d$, where, A is the area of the beam, d is the distance between the contact plate and cantilever beam, and ϵ is the permittivity of the insulating medium between the cantilever beam and the contact plate.

The Appellant argues, on Page 9 of the Appeal Brief that Regarding **Claim 11**, Zavracky does not disclose that the characteristic hysteresis curves of the first and second MEMS elements are centered around a common centerline in the operational diagram.

Zavracky, in Figures 8 and 11 shows an array of MEMS elements (MEMS elements 10 of 121-126 in Figure 8 and 140-147 in Figure 11) and the logic states of the MEMS elements or encoding is identified by interrogation. In Column 7, lines 49-53, Zavracky discloses, "Interrogation is performed by applying a ramped d-c voltage (which includes all of the threshold voltages being interrogated) to communications bus 127, 128 and monitoring the second derivative of the current in the line." Figure 12 of Zavracky shows the encoding of the MEMS devices of Figure 11, and in Column 7, lines 46-49, Zavracky discloses, "The shunt closure threshold voltages are selected above the normal operating range of the equipment at the post, station, or operating site." Therefore, Zavracky's characteristic hysteresis curves of MEMS elements 10 are centered around the operating range or center of the operating range, and meets the limitation of Claim 2.

Appellant's arguments regarding **Claim 13**, on Page 11 of the Remarks, are substantially same as that toward Claim 1. Therefore, please see the response to Claim 1 above.

Regarding Appellant's arguments toward **Claims 3-8, 12, and 14-20**, please see the response to Claim 1 and Claim 13 above.

II. Rejection of claims 1-4, 6-9, and 12-20 under 35 U.S.C. § 103(a) over Miles '532 in view of Sugahara

The Appellant argues on Page 14 of the Appeal Brief that regarding Claim 1, Miles '532 does not use a single control voltage to access array.

In response, Examiner notes Miles '532 teaches a control voltage, Vbias applied to the MEMS elements (IMOD device 10 implemented as MEMS elements, see Paragraph 17, 19) in the array. Miles '532 in Paragraph 28, teaches that hysteresis curve 50 of Figure 5 has a hysteresis width of 2.8 volts (Vclose or Vactuation of 7.8 volts and Vopen or Vrelease of 5.0 volts), and that it is possible to choose a value of Vbias between 5 volts and 7.8 volts to keep the devices in driven state. So the IMOD device 10 of Figure 5 uses a control voltage, Vbias as all the IMODS of the device have the opening voltage and closing voltage between 5.0 volts and 7.8 volts. It is true that primary reference, Miles '532 does not specifically disclose that the control voltage applied to all the MEMS is a single control voltage, and the secondary reference, Sugahara is relied upon for the teaching a single control voltage applied to all MEMS elements in an array. In Figures 9, 11, Sugahara discloses an electronic device comprising an array of MEMS elements 230a where a single control voltage is applied

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to all the MEMS elements (see a single voltage V1 is applied to top array, V2 to the next array).

The Appellant argues on Page 15 of the Appeal Brief that Miles '532 does not disclose a MEMS device with different widths because Miles '532 does not disclose variations in a device with hysteresis.

Examiner respectfully disagrees. As discussed above, Miles '532 in Paragraph 28, teaches that hysteresis curve 50 of Figure 5 has a hysteresis width of 2.8 volts (V_{close} or $V_{actuation}$ of 7.8 volts and V_{open} or $V_{release}$ of 5.0 volts). In paragraph 29, Miles teaches the hysteresis curve 80 of Figure 7 having a wider hysteresis width 4.5 volts (V_{close} or $V_{actuation}$ of 9 volts and V_{open} or $V_{release}$ of 4.5 volts). Miles teaches the use of adding a further layer comprising Al_2O_3 to the thin film layers of SiO_2 for changing the threshold voltages and hysteresis width of the MEM devices (see Paragraph 26-27).

Figure 3 of Miles, which the Appellant used for arguments, is used for illustration of IMOD devices with SiO_2 transparent layer and not having significant hysteresis ($V_{actuation}$ and $V_{release}$ too close), and therefore, difficult to select a V_{bias} to keep all IMOD devices 10 (Paragraph 22); Figures 5 and 7 with additional Al_2O_3 layer to have distinctive hysteresis for the devices are the embodiments of Miles of invention.

The Appellant argues on Page 15 of the Appeal Brief that the existence of variations does not disclose a MEMS device such that a hysteresis curve of a MEMS element is fully located within another hysteresis curve of another MEMS element.

In response, Examiner notes that “the variations of Miles ‘532” referred by the Appellant are with respect to Figure 3 of Miles ‘532. As discussed above, Figure 3 and Paragraph 22 of Miles, is used to illustrate that it is difficult to select a Vbias to keep all IMOD devices 10 with SiO₂ transparent layer and not having significant hysteresis (Vactuation and Vrelease too close). Figures 5 and 7 with additional Al₂O₃ layer to have distinctive hysteresis for the devices are the embodiments of Miles of invention. The hysteresis curve 50 of Figure 5 has a hysteresis width of 2.8 volts (Vclose or Vactuation of 7.8 volts and Vopen or Vrelease of 5.0 volts), and the hysteresis curve 80 of Figure 7 having a wider hysteresis width 4.5 volts (Vclose or Vactuation of 9 volts and Vopen or Vrelease of 4.5 volts), and curve 8 fully encloses curve 50.

The Appellant argues on Page 17 of the Appeal Brief that regarding **Claim 2**, nothing in Miles ‘532 definitely discloses that the opening and closing voltages are different from one MEMS element to another MEMS element.

In response, Examiner notes that Claim 2 further limits the array of Claim having the first and second MEMS elements to have an additional MEMS element. Miles ‘532 discloses MEMS elements in addition to the first and second MEMS elements. IMOD 10 is comprised of an array of MEMS devices (see Paragraph 20).

The Appellant argues on Page 17 of the Appeal Brief that regarding **Claim 11**, Miles ‘532 does not teach characteristic hysteresis curves of the first and second MEMS elements centered around a common centerline in the operational diagram.

In response, Examiner notes that regarding Claim 11, Miles ‘532 and Sugahara discloses MEMS devices with different hysteresis width as shown in the rejection of

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Claim 1, and response to arguments to Claim 1 above. Miles '532 and Sugahara do not specifically disclose that hysteresis curves of the first and second MEMS elements are centered around a common centerline, and that would be obvious to one of ordinary skill in the art to center the hysteresis curves around a common centerline to easily apply the bias voltage. Please also note that Appellant's arguments are directed to Figure 3, and Paragraph 22 of Miles '532. Miles uses Figure 3, and Paragraph 22 for illustration of IMOD devices with SiO₂ transparent layer and not having significant hysteresis (V_{act} and $V_{release}$ too close), and therefore, difficult to select a V_{bias} to keep all IMOD devices 10 (Paragraph 22); Figure 5 and 7 with additional Al₂O₃ layer to have distinctive hysteresis for the devices are the embodiments of Miles of invention.

Appellant's arguments regarding **Claim 13**, on Pages 18-19 of the Remarks, are substantially same as that toward Claim 1. Therefore, please see the response to Claim 1 above.

The Appellant argues on Page 19 of the Appeal Brief that regarding **Claim 19**, nothing in Miles '532 suggests that the variable capacitor takes on at least four different capacitance values.

Regarding Claims 19, both Miles '532 and Sugahara teach electronic devices (IMOD 10 of Miles '532 and film display device in Figure 9 of Sugahara) which are MEMS capacitors, with movable electrode and fixed electrode and an insulating medium in between, such that the electronic device comprises a variable capacitor. For example, Figures 1-2 of Miles '532 shows one device of the stack of MEMS capacitors, with reflective layer 14 as the movable electrode and electrode 20 and transparent layer

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12 as the fixed electrode and air gap 16 as the insulating medium, Figure 2 shows upon application of bias voltage 14 in driven or actuated state. When a bias voltage is applied, each of the MEMS capacitor of the electronic device having characteristic hysteresis curves, with two states open or closed, can cause the variable capacitor to take a plurality of states, for example, when two capacitors are present, each having open and closed can cause at least four different states (00, 01, 10, 11). See also response to arguments toward Claim 1 above.

Regarding Appellants arguments on Page 19 of the Appeal Brief toward **Claims 14-18 and 20**, please see the response to Claims 1 and 13 above.

III. Rejection of Claim 5 under 35 U.S.C. § 103(a) over Zavracky in view of Miles '562

Regarding Appellant's arguments on Page 20 of the Appeal Brief regarding Claim 5, Examiner notes that the secondary reference Miles '562 is relied upon for the teaching of the limitation, an input for a single control voltage for the MEMS device 410 is from a transistor 404 (see Figure 4C).

Examiner further notes that the secondary reference Miles '562 discloses in Figures 4A-C various states of IMOD device as a function of voltage (see state 0, state 1, and state 2 as V_{bias} is varied, Figure 4A), hysteresis curves 400, 402 of two devices of the IMOD device showing different hysteresis characteristics, i.e., different opening voltages and closing voltages for each device (Figure 4B), and a single control voltage connection to individual devices of IMOD 410, and the input of the single control voltage connected to a transistor (see input terminal of control voltage connection to transistor

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404, Figure 4C). Hysteresis curves 400 and 402 having different hysteresis width, 400 wider than 402 such that when centered 402 will be within 400, are corresponding to IMODs 300 and 302 of Figure 3A. Please also note that two MEMS devices in Figure 3C of Miles '562 with different length and thickness for the membrane or beam, resulting in different width, with shifting of opening and closing voltage of the hysteresis curve of Figure 4B (Zavracky discloses only changing the length of the cantilever beam). Thus Miles '562 also discloses two MEMS devices in the same array IMOD array wherein the opening voltage and closing voltage of the first MEMS element being different from the opening voltage and closing voltage of the second MEMS device (Claims 1) and the connection of the single control voltage to a transistor.

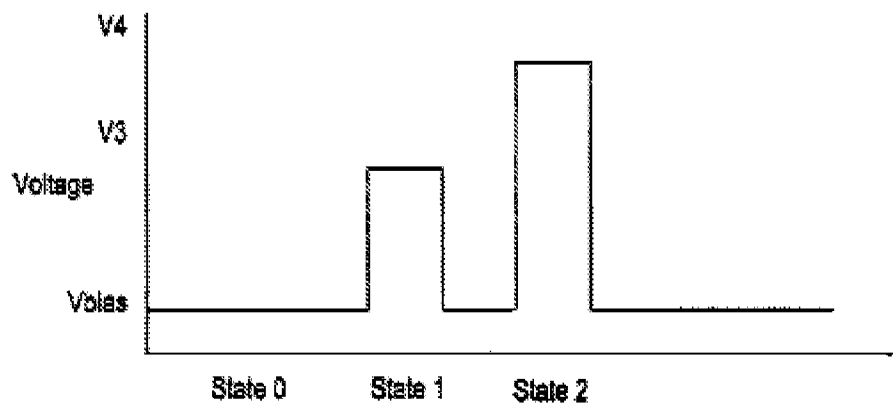


FIG. 4A

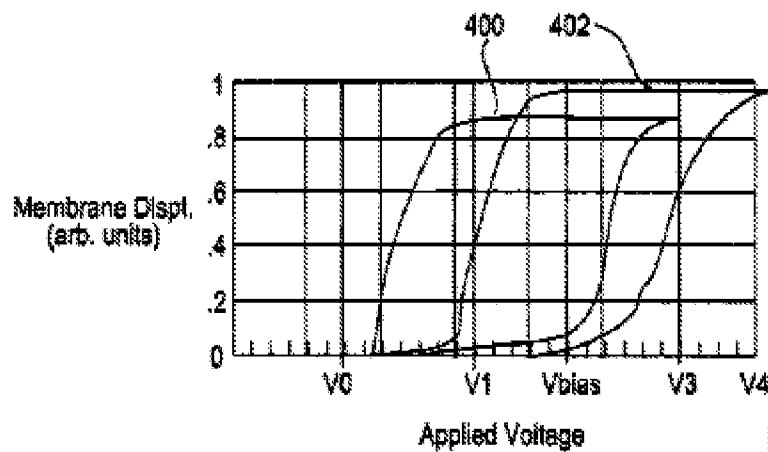


FIG. 4B

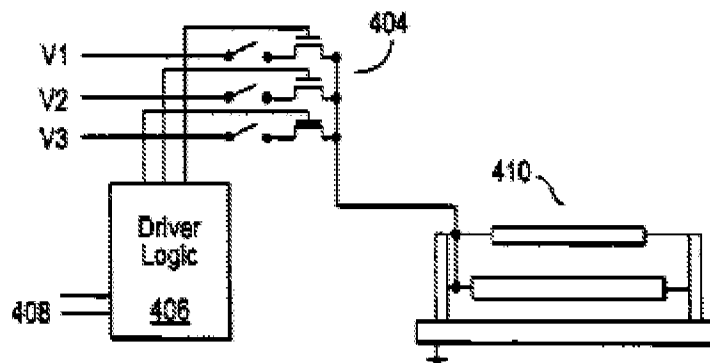


FIG. 4C

IV. Rejection of Claim 5 under 35 U.S.C. § 103(a) over Miles '532 in view of Sugahara and Miles '562

Appellant argues on Page 20 of the Appeal Brief that regarding Claim 5, that Miles '562 does not cure the deficiencies of Claim 1.

In response, Examiner notes that the combination of Miles '532 and Sugahara teaches all the limitations of Claim 1 as shown in the rejection above. Please see the response to arguments toward Claim 1 above. Miles '562 is relied upon for the teachings of an input for a single control voltage for the MEMS device 410 is from a transistor 404 (see Figure 4C).

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(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Lucy Thomas

/Lucy Thomas/

Examiner, Art Unit 2836

Conferees:

/Jared J. Fureman/

Supervisory Patent Examiner, Art Unit 2836

/Darren Schuberg/

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